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PHYSICAL GEOGRAPHY.—*Why the Mayan cities of the Petén District, Guatemala, were abandoned.*[1] C. WYTHE COOKE, U. S. Geological Survey.

Two thousand years ago what is now the Petén District of Guatemala was the seat of a flourishing Mayan empire. Its massive temples and palaces still mark the sites of large cities which endured for many generations but were finally abandoned. Today, that once-populous region is, for the most part, totally uninhabited. The great cornfields which fed its people have reverted to the jungle, and the ruins of its public buildings lie hidden in a dense forest. The few permanent habitations are on the banks of perennial lakes and rivers along the main route of travel across the District. The remainder of the region is accessible only by means of narrow trails kept open by chicleros or cut by exploring archeologists.

My acquaintance with the Petén District was gained in March and April, 1931, when I was sent by the Carnegie Institution of Washington to study the geology of the region accessible from the camp of the Institution's Department of Historical Research at Uaxactún. I entered Guatemala at Yaloche, a customs house on the frontier, a day's ride northwest of Cayo, British Honduras, travelled 3 days westward to Uaxactun, spent 10 days there, and proceeded southward past Tikal to Remate, a settlement at the eastern end of Lake Petén. From this lake I followed a well-travelled road northeastward past Lake Macanxé to Yaxhá, a settlement between two lakes, thence to Tikan Sakan and down the valley of Río San Felipe to Fireburn on the frontier of British Honduras.

[1] Received June 5, 1931. Published by permission of the Acting Director of the U. S. Geological Survey.

Travel in the Petén is slow and tedious. The length of a day's journey varies according to the season and is determined in large part by the distance between water holes, for there are few perennial streams and many of the water holes become dry after the end of the rainy season.

Uaxactún lies on or near the divide that separates the drainage systems of the Gulf of Honduras from those of the Gulf of Mexico. Streams east of Uaxactún flow into Río Hondo or into Belize River, which empty into the Gulf of Honduras, but water falling west of Uaxactún finds its way into tributaries of the Usumacinta, which flows into Campeche Bay.

Because of the thick cover of forest which cuts off the view in all directions, it is difficult to visualize the topography of the Petén. The clearings around the camp at Uaxactún, which are on the lowlands, show only a shallow depression containing a plant-covered water hole (*aguada*), a grassy flat, and hillocks about twenty feet high, beyond which the view is stopped by the edge of the forest. Even from the top of the highest temple, nothing can be seen but the enclosing jungle. But from the window of a ruined Mayan building which is perched on a mound at the edge of the upland 150 feet above the aguada, one can look eastward over the tree tops and the clearings, across a wide forested plain to low, broken ridges on the horizon.

There are two very different kinds of topography in this part of the Petén—uplands and lowlands, or *bajos*. The uplands are hills and ridges of limestone which rise to a maximum height of several hundred feet above the bajos. They are barely covered by a thin soil of black clay, and are dotted here and there with sinks. In the neighborhood of Uaxactún, the highest hills stand 650 or 700 feet above sea level, and the bajos about 500 or 550 feet. The bajos are flat plains with almost no perceptible relief. They are underlain by tough black carbonaceous clay. The uplands are clothed with a fairly open forest containing many tall, large trees, such as mahogany, chicle, and ceiba but comparatively little underbrush. The bajos are covered with a tangled mass of low gnarled and twisted trees, such as logwood. Many of the trees in the bajos are small-leaved and thorny, and are festooned with large vines. During the rainy season the bajos are flooded; at the beginning of the dry season they are floored with deep tough mud which, later in the year, drys hard and cracks. At all seasons they are very unpleasant to travel through.

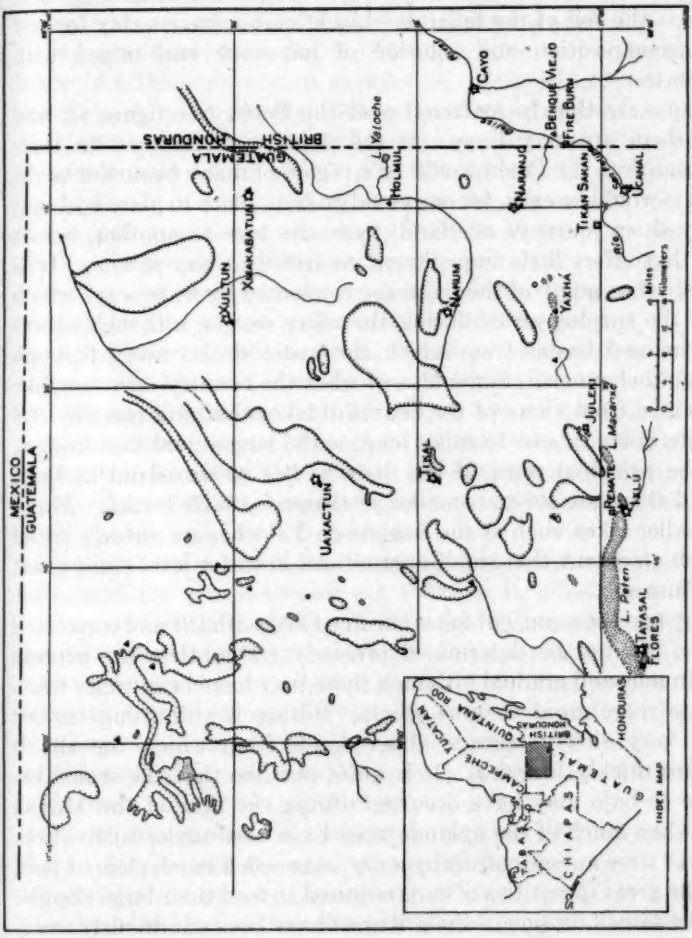


Figure 1. Sketch map of part of Guatemala showing bajos and lakes. Stars indicate places whose geographic position has been determined astronomically by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. Solid triangles indicate Mayan ruins. Based on a map made by F. Vans-Agnew and Didier Masson for the P. W. Shufeldt Cls.

The bajos evidently once were lakes. They are still lakes during the rainy season, but they have been so nearly filled with silt that a slight depression of water level due to run-off or evaporation reduces them to ponds or drains them completely. The source of the clay that fills them is the soil of the uplands—black, carbonaceous clay formed by the decomposition and solution of limestone and mixed with organic matter.

The bajos are thickly scattered over the Petén (see figure 1), and some of them are very large. If the bajos were restored to their former condition, the Petén would be a region of many beautiful lakes. Travel in it would be easy, for one could go from place to place by boat, with only short journeys overland, from one lake to another, across country that offers little impediment to travel at any season. It is quite likely that many of the bajos are connected by waterways which carry off the surplus water during the rainy season, although others occupy enclosed basins from which the water drains away through underground channels. Some idea of what the country once was like can be gained from views of the beautiful lakes that still remain. Of these Lake Petén, about 18 miles long, is the largest and best known. Flores, the principal town of the district, lies on an island in Lake Petén and there are several smaller settlements on its banks. Many of the smaller lakes, such as the Laguna de Yaloche, are already silted up to such an extent that small fluctuations in water level cause great changes in area.

How long ago these ancient lakes became filled with silt and converted into bajos can not be determined precisely. Doubtless the process was continuous and gradual although there may have been times when silting was more rapid than at others. Silting is still going on but probably very slowly because the uplands from which the silt is derived are thickly forested. It is quite possible that the transition from lake to bajo may have occurred during the time of the Mayan Empire, when much of the uplands must have been under cultivation. The Mayas were an agricultural people and needed much cleared land to raise the great quantities of corn required to feed their large population. The rate of erosion of the soil must have been enormously accelerated when the forest was cut and the cultivated soil was exposed to the full force of the torrential rains. One may imagine the Petén when first occupied by the Mayas to have had a thick fertile black soil. During the many centuries of the Mayan occupation more and more of the soil was washed away until the bare limestone was exposed.

Then the land was abandoned and reverted to the jungle, soil erosion was greatly retarded, and today, after the lapse of several centuries, the ground is covered by a thin but fairly even coating of black clay through which the rock still shows in many places. Soil is probably being formed now more rapidly than it is being washed away.

One can scarcely imagine the Petén, in its present condition, as the home of a large permanent population. One difficulty is the lack of an adequate water supply. There are few permanent water holes in the Petén and some of the old Mayan town sites are without any obvious present source of water. The Mayas may have depended upon stores of rain water to tide them over the dry season, just as Belize today gets its entire water supply from the clouds, but the rainfall is much more seasonal in the interior than at Belize. Another difficulty is the lack of transportation facilities. If the geography during the time of the Mayan occupation had been like the present, all the provisions and merchandise would have had to be carried to or from the cities on the backs of men (for the Mayas had no beasts of burden), and the bajos would have offered almost impassable barriers to transportation during part of the year. If, however, the bajos were permanent lakes during the time of the Mayan occupation, there was plenty of water throughout the whole year and commerce was speeded at all seasons by water transportation.

Another way in which the transition from lakes to bajos may have influenced the occupation of the Petén is its effect upon the health and comfort of the people by the increase of mosquitoes. As long as the water remained deep near shore, mosquitoes probably were not very numerous, for their larvae would have fallen prey to fishes, but when the deep water was converted into swamps and marshes, swarms of mosquitoes must have plagued the people. If, about this time, malaria was introduced into the country, sickness and death may have taken their toll of the population.

Some of the factors, then, that may have caused the decline of the Mayan Empire and the depopulation of the Petén are (1) erosion of the soil and the consequent scarcity of arable land, (2) silting of the lakes and the destruction of water transportation, (3) diminution of the water supply during the dry season, (4) increase in the number of mosquitoes, and (5) introduction or increase of malaria.

BOTANY.—*Additional Costa Rican mosses, II.*[1] EDWIN B. BARTRAM, Bushkill, Pennsylvania.

Since the last paper on this subject was published the continued interest of Professor Manuel Valerio in the Costa Rican mosses has resulted in an accumulation of about 155 numbers, among which are some items of unusual scientific value.

The appended list includes only the species not recorded in the two previous publications (1, 2), to which has been added the description of a unique moss collected by Mr. Standley, which not only adds a new genus to the moss flora of North America but at the same time again emphasizes the close connection between the mosses of Costa Rica and those of the Cordilleran regions to the southward.

A complete series of specimens, including the types of the species described as new, has been deposited in the National Herbarium at Washington, D. C., and in the herbarium of the writer.

DICRANACEAE

DICRANELLA SUBINCLINATA Lor.

Chitaría, Province of Cartago, alt. 700 m., Dec. 20, 1928, M. Valerio no. 239.

Previously known from Florida, the Antilles, Mexico and Panama.

SYMBLEPHARIS HELICOPHYLLA Mont.

Syn.—*Symblepharis Oerstediana* C.M.

Volcán Irazú, alt. 3300 m., April 7, 1929, M. Valerio no. 297.

This is a decidedly more robust form than the plants I am familiar with in the southwestern United States and the leaf cells of the upper half of the blade are frequently in two layers. These characters are, however, by no means constant and it seems doubtful if the Costa Rican collections can be segregated from the type.

CAMPYLOPUS DONNELLII (Aust.) Lesq. & James.

La Hondura, Province of San José, alt. 1400 m., Jan. 15, 1929, M. Valerio no. 261.

There is no record of this species outside of Florida, as far as I am aware, so that its occurrence in Costa Rica is of uncommon interest. A single fruiting plant in the above collection is worthy of a brief description, as the sporophyte has, until now, been unknown.

Sporophyte-bearing plant 2.5 cm. high; stem leaves erect-appressed, comose at summit; seta solitary, 5–6 mm. long, sinuose, smooth; capsule (immature) erect, symmetrical, 1 mm. long, slightly furrowed when dry; lid erect or slightly oblique, about 0.65 mm. high; peristome and calyptra unknown.

[1] Received April 25, 1931.

POTTIACEAE

MERCEYA AGOYANENSIS (Mitt.) Broth.

Volcán Barba, alt. 2500 m., Dec. 16, 1930, M. Valerio no. 343.

So far as I know, this is the first species of *Merceya* to be recorded from tropical North America. The plants are somewhat larger than those of the type collection of *M. agoyanensis*, of Ecuador, which I have seen through the kindness of Mr. R. S. Williams, but the shape and structure of the leaves are identical in every particular.

RHAMPHIDIUM MACROSTEGIUM (Sull.) Mitt.

Chitaría, Province of Cartago, alt. 700 m., Dec. 20, 1928, M. Valerio no. 229*a*.

Previously known from the Antilles and South America but new to Costa Rica.

Leptodontium Orcutti Bartr., sp. nov.

Figures 8–12

Dioicous? male flowers not seen. Stems up to 1.5 cm. long, densely caespitose, yellowish-green above, pale-brown below, more or less pale-tomentose except at the tips, flexuose, simple or branched; leaves crowded toward the tips, more distant below, appressed with incurved slightly crisped points when dry, spreading to squarrose-recurved when moist, oblong-ligulate, sheathing at the base, carinate-concave above, abruptly acute, about 2 mm. long by 0.5 mm. wide; margin slightly reflexed in the middle, crenulate with projecting papillae, flat and spinulose-serrate above; costa pale-yellow, about 75μ wide, vanishing just below the apex, convex and minutely papillose on the back above; basal leaf cells rectangular, smooth with yellowish pellucid walls, shorter and subquadrate at the margins, quickly becoming shorter and papillose upward, upper cells rounded-hexagonal, 7–10μ in diameter, rather obscure, densely papillose with numerous low papillae, not or hardly incrassate except toward the margins where 4–6 rows are rather strongly incrassate with irregularly thickened pellucid walls; perichaetial leaves similar to the stem leaves, about 3 mm. long, the inner erect and strongly sheathing; seta about 12 mm. long, pale yellow; capsule erect or slightly inclined, cylindrical, 1.5–2 mm. long, stramineous, exothecal cells rectangular, thin-walled, delicate and pale except 5–7 rows around the mouth which are subhexagonal or transversely rectangular with dark, reddish-brown incrassate walls; peristome about 0.2 mm. long, of 16 pale, obliquely papillose-striate teeth, divided to the base into 2 linear, somewhat confluent forks; lid erect, conic-rostrate, 0.5 mm. long; calyptra not seen; spores greenish-brown, granulose, 14–18μ in diameter.

Type: Mineral del Chico, State of Hidalgo, Mexico, May 16, 1925, C. R. Orcutt no. 6731.

Other collections: Mexico: Pont de la Venta, Valle de Mexico, Bro. Arsène no. 1391. North Carolina; Chestnut Bald, Holz. Musc. Ac. Bor.-Amer. no. 264. Costa Rica; Volcán Irazú, alt. 3300 m., M. Valerio no. 293.

This species approaches *L. flexifolium*, of Europe, very closely but seems to be consistently distinct in several important particulars. The leaves are

more broadly bordered with thick-walled cells often 5–6 rows wide, the capsule is paler in color, the exothecal cells are thin-walled, and the peristome teeth are obliquely papillose-striate. The plants collected by Dr. Grout in North Carolina, and issued by Holzinger as no. 264 of his exsiccati, under the name *Didymodon flexifolius*, while sterile, are indistinguishable from the Mexican and Costa Rican collections, and I am satisfied that they should be referred here rather than to the European species, which does not seem to occur in North America.

Sterile plants of this species were received from my good friend M. Thériot as an undescribed species of *Leptodontium*, from Bro. Arsène's Mexican collections, but as Orcutt's specimen was in good fruiting condition M. Thériot generously suggested that his own name be suppressed.

Leptodontium filescens (Hampe) Mitt. var. **denticulatum** Bartr., var. nov.
Figures 1–7

More robust than the species, with longer, more sharply denticulate leaves, more rounded upper leaf cells, and setae up to 18 mm. long.

Type: Southern slope of the Volcán de Turrialba, near the Finca del Volcán de Turrialba, Costa Rica, alt. 2000-2400 m., Feb. 22, 1924, Paul C. Standley no. 35160*a*. c. fr.

Other collections: near the type locality, Standley no. 34953; near Finca la Cima, above Los Lotes, north of El Copey, Standley no. 42777; Volcán Poás, alt. 2500 m., M. Valerio nos. 284 & 285*a*.

These Costa Rican specimens do not seem to differ structurally from the species but they are uniformly coarser. The stem leaves are up to 2.5 mm. long, sharply denticulate toward the apex, and the setae are about twice as long as in the type collection of the species from Colombia. Numerous axillary claviform or cylindrical, septate gemmae occur in all of the collections representing both the type and the variety.

TORTULA MINIFOLIA (Sull.) Mitt.

Chitaría, Province of Cartago, alt. 700 m., Dec. 20, 1928, M. Valerio no. 221. Previously known from Cuba, Bolivia and Peru but new to Costa Rica.

BRYACEAE

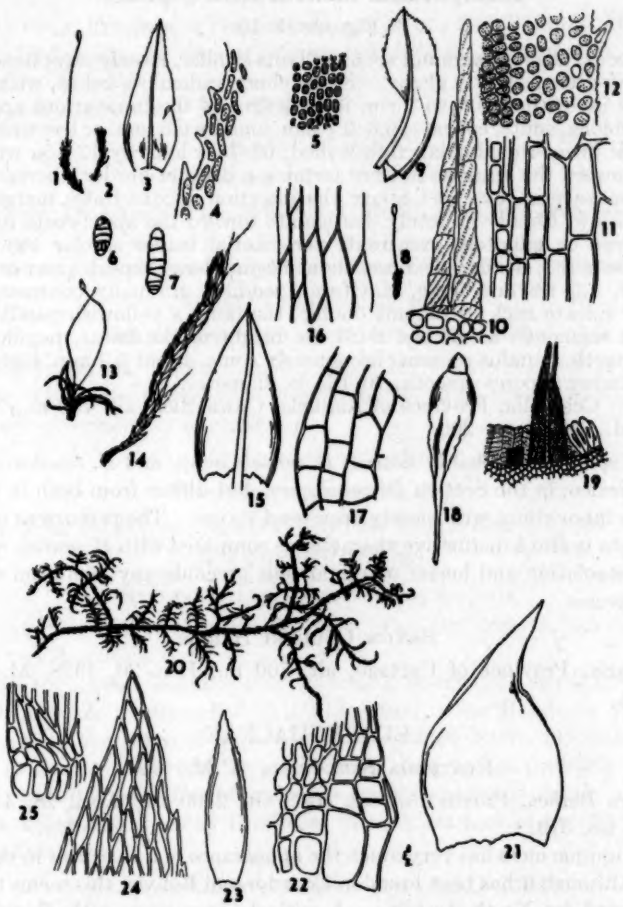
STABLERIA OSCULATIANA (DeNot.) Broth.

Volcán Irazú, alt. 3300 m., April 7, 1929, M. Valerio nos. 302 & 307.

I have referred these collections to the above species rather than to *S. tenella* (Mitt.) Broth. as the setae are all decidedly longer than the leaves. Specimens of the latter species in the writer's herbarium and in the herbarium of the New York Botanical Garden show considerable variation in this respect and it may, eventually, be necessary to reduce them to one species, in which event, *S. osculatiana*, being the older name, would be retained.

MIELICHHOFERIA PRATICOLA Card.

Volcán Irazú, alt. 3300 m., April 7, 1929, M. Valerio no. 303. Previously known only from Mexico.



Figures 1–7. *Leptodontium filescens* (Hampe) Mitt. var. *denticulatum* Bartr., var. nov. 1.—Fertile plant × 1. 2.—Sterile stem × 1. 3.—Stem leaf × 9. 4.—Upper leaf margin × 240. 5.—Upper leaf cells × 240. 6 and 7.—Gemmae × 40.

Figures 8–12. *Leptodontium Orcutti* Bartr., sp. nov. 8.—Fertile plant × 1. 9.—Stem leaf × 17. 10.—Part of peristome × 240. 11.—Lower leaf cells × 240. 12.—Upper leaf cells and margin × 240.

Figures 13–19. *Brachymenium filescens* Bartr., sp. nov. 13.—Plants × 1. 14.—Innovation × 5. 15.—Leaf of innovation × 40. 16.—Upper leaf cells × 240. 17.—Basal angle of leaf × 240. 18. = Capsule × 12. 19.—Part of peristome × 80.

Figures 20–25. *Acanthocladium costaricense* Dix and Bartr., sp. nov. 20.—Plant × 1. 21.—Stem leaf × 40. 22.—Basal angle of stem leaf × 240. 23.—Branch leaf × 40 24.—Apex of branch leaf × 240. 25.—Basal angle of branch leaf × 240.

Brachymenium filescens Bartr., sp. nov.

Figures 13–19

Dioicous? male flowers not seen. Plants slender, loosely caespitose, sordid yellowish-green, slightly glossy. Stems short, radiculose below, with slender flexuose innovations up to 1 cm. long; leaves of the innovations appressed, ovate-oblong, acute, concave, 0.6–0.7 mm. long by 0.3 mm. or less wide; upper leaf cells linear-rhomboidal, thin walled, 60–75 μ long by 12–15μ wide, narrower toward the margins but not forming a distinct border, shorter toward the base, several rows just above the insertion subquadrate; margin erect, entire below, usually minutely denticulate toward the apex; costa lutescent, percurrent or minutely excurrent; perichaetial leaves similar but slightly longer; seta red, slender, flexuose, about 14 mm. long; capsule erect or slightly inclined, 1.5–1.8 mm. long, claviform, reddish, gradually contracted to a slightly sulcate neck; peristome double, the inner a yellowish papillose tube without segments, about one third the height of the linear, papillose, well spaced teeth, annulus present; lid obtusely conic, about 0.3 mm. high; calyptra unknown; spores smooth, 10–12μ in diameter.

Type: Cebadilla, Province of Alajuela, Costa Rica, alt. 700 m., Nov. 14, 1928, M. Valerio no. 209.

This species is probably nearest *B. murale* Schp. and *B. vinulosum* Card. from Mexico, in the Section *Dicranobryum*, but differs from both in the long flexuose innovations with closely appressed leaves. The percurrent or excurrent costa is also a distinctive character as compared with *B. murale* while the longer areolation and longer marginal cells preclude any confusion with the other species.

Bryum Crugeri Hampe

Chitaría, Province of Cartago, alt. 700 m., Dec. 20, 1928, M. Valerio no. 222.

EUSTICHIACEAE

Eustichia Spruceana (C.M.) Par.

Piedra Blanca, Province of San José, alt. 2100 m., April 28, 1929, M. Valerio no. 310.

This unique moss has very much the appearance of a *Fissidens* to the naked eye. Although it has been found in Ecuador and Bolivia, this seems to be the first record for North America. A critical comparison with *E. miradorica* (C. M.) Par. would be very desirable but Dr. Reimers has informed me that, unfortunately, no specimen of the Mexican plant can be located in the herbarium of the Botanical Museum in Berlin-Dahlem.

BARTRAMIACEAE

Bartramia costaricensis C.M.

Volcán Irazú, alt. 3300 m., April 7, 1929, M. Valerio nos. 305–308.

Both collections are sterile but the vegetative characters correspond very well with Müller's description.

PHILONOTIS CRASSINERVIA Broth. & Par.

Santa Cruz, Province of Guanacaste, alt. 50 m., Dec. 24, 1928, M. Valerio no. 243; La Estrella, Province of Cartago, alt. 1700 m., in water, Jan. 26, 1929, Valerio no. 260.

Previously known only from Colombia.

HOOKERIACEAE

DALTONIA TENUIFOLIA Mitt.

San José, Province of San José, alt. 1135 m., Nov. 30, 1928, M. Valerio no. 205*a*.

An interesting northward range extension of a rare South American species.

BRACHYTHECIACEAE

BRACHYTHECIUM LAXIRETICULATUM Card.

Volcán Irazú, alt. 3300 m., April 7, 1929, M. Valerio nos. 300 & 301.

These collections match very closely the Mexican species to which they have been provisionally referred.

FABRONIACEAE

FABRONIA FLAVINERVIS C.M.

Santa Ana, alt. 900 m., June 15, 1929, M. Valerio nos. 325, 326, 327, 328.

PLAGIOTHECIACEAE

STEREOPHYLLUM CULTELLIFORME Sull.

Chitaría, Province of Cartago, alt. 700 m., Dec. 20, 1928, M. Valerio no. 238 New to Costa Rica.

In this connection an opportunity is offered to correct a signal error which Mrs. Britton has kindly called to my attention. The Honduras plants described under the name of *Rhynchostegium patulum* Bartr. (3) undoubtedly belong in *Stereophyllum* and are exceedingly close to and probably identical with *S. cultelliforme*. The inflorescence of this species is clearly autoicous and not dioicous as given by Brotherus in both editions of the Natürlichen Pflanzenfamilien.

STEREOPHYLLUM LEUCOSTEGIUM (Brid.) Mitt.

Santa Cruz, Province of Guanacaste, alt. 50 m., Dec. 24, 1928, M. Valerio no. 242.

SEMATOPHYLLACEAE

APTCHELLA AMERICANA (Card.) Broth.

Volcán Barba, alt. 2700 m., Dec. 16, 1930, M. Valerio no. 350.

Cardot originally described this species from Mexico. It was subsequently collected by Mrs. Britton in Jamaica and Prof. Valerio's collection now extends its known range to Costa Rica. The characteristic propagulae at the tips of the branches are very abundant in the Costa Rican plants but the sporophyte is still unknown.

Acanthocladium costaricense Dix. & Bartr., sp. nov.

Figures 20–25

Plants in extensive, pale yellowish-brown glossy mats. Stems elongate, wiry, prostrate, proliferously branched; branches ascending, bipinnate, the ultimate branches somewhat flattened, curved and crisped when dry; leaves dimorphous, stem leaves erect-appressed with slightly curved or subfalcate points, ovate, short-acuminate, entire or minutely denticulate, about 1 mm. long by 0.5 mm. wide; margin more or less narrowly reflexed, branch leaves rather complanate, much smaller than the stem leaves, oblong-lanceolate, bluntly acute, denticulate above the middle, 0.4–0.5 mm. long by about 0.13 mm. wide; leaf cells smooth, echlorophyllose, the upper linear, 35–40μ long by 3–4μ wide, a few rows at the extreme base shorter, slightly incrassate and porose, alar cells few, oblong, golden-brown or hyaline, supra-alar cells smaller, subquadrate to oblong, hyaline or colored, nerve very short and double or wanting.

Type: On tree, vicinity of Santa María de Dota, Province of San José, Costa Rica, alt. 1500–1800 m., Dec. 26, 1925–Jan. 3, 1926, Paul C. Standley & Juvenal Valerio no. 43395.

Although the fruit of this moss is unknown the general habit and vegetative characters correspond very closely to those of the genus *Acanthocladium*. If this inference is correct the extension of such a purely austral genus into the range of the North American moss flora is especially noteworthy. *A. subnitidum* (Hampe) Broth., from Colombia, suggested a likely comparison and I am indebted to Mr. H. N. Dixon for the following comments which were made after comparing the Costa Rican moss with the type collection of the Colombian species in the Hampe herbarium.

"*H. subnitidum* is much more robust and rigid, both in branches and leaves. Nearly all the branches taper to a straight, rigid, narrow, cuspidate, microphyllous flagellum. The leaves are considerably larger, broader below, longly and finely acuminate and scarcely glossy. Branches all straight."

SEMATOPHYLLUM CUSPIDIFERUM Mitt.

La Hondura, Province of San José, alt. 1400 m., Jan. 15, 1929, M. Valerio no. 270.

The robust habit and filiform-acuminate leaves distinguish this collection from any of the *S. caespitosum* group.

HYPNACEAE

ISOPTERYGIUM FECUNDUM R. & C.

Volcán Poás, alt. 2500 m., Feb. 7, 1929, M. Valerio no. 285.

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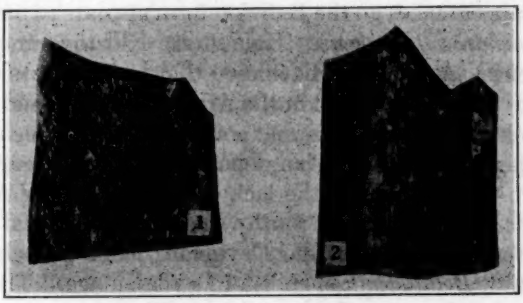
(3) Bartram, E. B. Field Mus of Nat. Hist., Bot. Ser. 4, No. 9, 359. 1929.

PALEOBOTANY.—*A* Bothrodendron *from Bolivia.*[1] EDWARD W. BERRY, Johns Hopkins University.

In a small collection of miscellaneous trails, fucoids (?), etc. from southeastern Bolivia submitted to me last year by C. F. Bowen of the Standard Oil Company of New Jersey there are three clearly marked specimens belonging to the Lepidophyte genus *Bothrodendron*, constituting, so far as I know, the first authentic record of this genus in South America.

The matrix varies from gray to rusty, and from a mudstone to a highly micaceous thin-bedded sandstone carrying flakes and patches of carbonized plant tissue. The *Bothrodendron* material occurs in the latter type of sediment and comes from two near-by localities—Quebrada Caigua and Quebrada Caiguami. All three specimens are small,



Figures 1 and 2.—*Bothrodendron* sp.

the two largest being figured. Two of these, including the original of fig. 1 are flattened patches of cuticle with the leaf bases as holes. The original of fig. 2 is an impression of a small branch preserving considerable of its original form. In fig. 1 the leaf scars are elliptical, about 1 millimeter wide and 1.5 millimeters long and are arranged in alternating whorls with a spacing, both transverse and longitudinal, of about 2.5 millimeters. The specimen exposes the inside of the cuticle so that the surface features are not visible. It does not, however, show any traces of ribbing. In the small axis shown in fig. 2, which is about 1.5 centimeters across, the leaf scars are slightly larger, more nearly circular, slightly farther apart, and somewhat elevated. The surface ornamentation is obsolete, but there is a distinct, although

[1] Received May 21, 1931.

faint, indication of slight ribbing. There is no reason to suppose that all three specimens do not belong to the same species.

This Bolivian *Bothrodendron* is not represented by extensive enough or complete enough material to warrant giving it a specific name so that it may be known simply as *Bothrodendron* sp. Indeed the specific limits of the fifteen to twenty species of *Bothrodendron* that have been described are, for the most part, rather vague, and certainly not reliable. Haughton originally described three species from the classic upper Devonian locality at Kiltorcan, Ireland, but Johnson[2] has rather clearly indicated the probability that but a single botanical species is represented at that locality, and Nathorst in particular has figured much good material from the upper Devonian of Bear Island illustrating the natural variation and the differences in appearance due to age and state of preservation.

As far as appearances go the Bolivian form appears to me to be most like *Bothrodendron kiltorkense* (Haughton) Kidston among the described species. A priori the likelihood that a single botanical species should range from Bear Island in the Arctic to Bolivia and New South Wales seem highly improbable, and conclusions from this resemblance regarding the age of the Bolivian deposit can not be regarded as conclusive. On the other hand the lack of known Lower Carboniferous (Mississippian) sediments in South America, and the abundance of shallow water lower and middle Devonian, lends probability to the conclusion that *Bothrodendron* sp. is of Devonian age. The sediments carrying it are referred to the Iquiri formation which is considered to be of Devonian, and probably upper Devonian, age.

Although *Bothrodendron* and its allies agree rather closely in habits and anatomy with some of the other Lepidophytes there is good ground for considering them as representing a distinct family—the Bothrodendraceae—which is, in some respects, intermediate between the Lepidodendraceae and the Sigillariaceae, being rather more like some of the former in anatomical features, and more like some of the latter in external features. Some of the fructifications attributed to the Bothrodendraceae resemble *Lepidostrobus* and others, *Bothrostrobus*, lack the sporophyll elongation so characteristic of the Lepidodendraceae and Sigillariaceae. The Bothrodendraceae are also somewhat earlier in their inception, for although they extend through the Carboniferous, they appear earlier and are relatively more abundant during the later Devonian and Lower Carboniferous (Mississippian).

The name *Bothrodendron* was proposed by Lindley & Hutton in 1833

[2] T. Johnson, Sci. Proc. Royal Dublin Soc., vol. 13, No. 34, 1913; vol. 14, No. 13, 1914.

with *Bothrodendron punctatum* as the genotype, a species marked by *Ulodendron*-like crateriform scars, now usually considered to represent the scars of deciduous branches. In 1860 Haughton proposed the generic term *Cyclostigma* (genotype *C. kiltorkense*) for material from the Irish upper Devonian, and in 1876 Boulay proposed the generic term *Rhytidodendron* (genotype *R. minutifolium*) for French material. It is only in more recent years that the generic identity of these has been accepted. The number of species is uncertain since many are founded wholly on external characters and insufficient material, and the appearance varies considerably with age. The leaf scars are always small, some show ligules and others do not, some show a central leaf-trace scar and two parachnoi, and others do not. The genus is especially abundant in the upper Devonian of Bear Island—the so-called Ursa stage of Heer—once believed to be intermediate in age between Devonian and Lower Carboniferous. It occurs in the Devonian of North America and Europe, in the Devonian or Lower Carboniferous of Europe, Asia, Africa and Australia, but has not heretofore been certainly collected in South America. In this connection attention should be called to the species *Lycopodiopsis derbyi* Renault[3] from the Brazilian coal measures, which is superficially similar to *Bothrodendron*.

Seward[4] recorded in 1922 a *Bothrodendron* (?) sp. from the Carboniferous of Paracas, Peru, the age of which he was inclined to regard as Lower Carboniferous. Gothan[5] has also discussed the flora from this locality in a recent publication, and has referred Seward's form to what he calls *Bothrodendron pacificum* Steinmann. Judging from the figures alone the Peruvian plant does not suggest *Bothrodendron* to me, and in any case it is not the same as the specimens under discussion.

In 1922 I described[6] much the largest collection of plants that was ever made at Paracas, personally collected, and after studying the local section and those around Lake Titicaca reached the conclusion that the age was not older than the Westphalian stage of the Upper Carboniferous. I see no reason for changing this opinion despite what can not but seem like a belated attempt on the part of Gotham to validate the original guess of Steinmann regarding the age.

Particular interest attaches to the other antipodean occurrences of

[3] David White, Final Rept. Brazilian Coal Comm., p. 437, pl. 5, fig. 11, 1908.

[4] A. C. Seward, Quart. Jour. Geol. Soc. London, vol. 78, p. 281, pl. 13, fig. 9 and text fig., 1922.

[5] W. Gothan, Neues Jahrb. Beil. Bd. 59, Abt. B, p. 296, pl. 13, fig. 3, 1928.

[6] E. W. Berry, Johns Hopkins Univ. Studies in Geology No. 4, pp. 9–42, pls. 1–8, 1922.

Bothrodendron in Africa and Australia, and it is unfortunate that this material, like that from Bolivia, is not good enough for precise comparisons. It is, perhaps, significant that both the African (*Bothrodendron leslii* Seward) and Australian (*Cyclostigma australe* Feistmantel) forms have been compared with *Bothrodendron kiltorkense*. As far as comparisons are possible with the poor material that served as the type of *Cyclostigma australe*[7] the Bolivian material could be referred to the same species, but in view of the nature of the remains this resemblance may have no significance.

ZOOLOGY.—*A* Microfilaria *from the blood of a wild rabbit.*[1] BENJAMIN SCHWARTZ and JOSEPH E. ALICATA, Bureau of Animal Industry, U. S. Department of Agriculture.

Under date of April 2, 1931, Dr. C. M. Hamilton, of the Western Washington Experiment Station, Puyallup, Washington, forwarded to the Bureau of Animal Industry at Washington, D. C., two blood smears, with the following comments:

"A farmer in Arlington, Washington, found a rabbit in a stupor, and when it died later he mailed it to us for examination. There were four ticks, including one female specimen, on the back of the neck. Postmortem examination revealed nothing except a congested liver. However, in blood smears from the heart, parasites resembling nematodes were noted. Blood taken from the heart and diluted with distilled water showed these parasites to be alive."

On further inquiry, Dr. Hamilton advised the writers that the host in question was *Lepus washingtonii*.

A microscopic examination of the two blood smears, one of which had been stained with methylene blue and the other with Wright's stain, revealed the presence of microfilariae, in addition to blood cells. The former appeared to be sufficiently well stained to enable the writers to make out the morphological details commonly recognizable in well stained preparations containing microfilariae.

Although the specific identity of filarids cannot always be determined on the basis of their larval characters, it is not improbable that the microfilariae in question are the immature forms of *Dirofilaria scapiceps* (Leidy 1886), the only filarid known from North American rabbits. However, the final determination of the identity of these microfilarids

[7] O. Feistmantel, Palaeontographica, Suppl. 3, p. 70, pl. 1, fig. 6, 1878.

[1] Received May 8, 1931.

will have to be based on investigations of the further development of these larvae in suitable mosquito or other arthropod intermediate hosts, and on the subsequent transmission of the infective larvae to rabbits through the bites of the infected intermediate host. For the time being the larvae in question are assigned to the collective genus *Microfilaria* Cobbold, 1880.

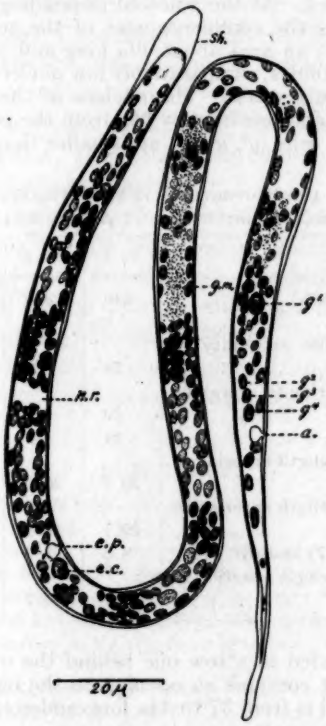


Figure 1.—*Microfilaria* species from *Lepus washingtonii*. *a*, anus; *e.c.*, excretory cell; *e.p.*, excretory pore; g^1, g^2, g^3, g^4, first, second, third, and fourth germ cells, respectively; *g.m.*, granular mass; *n.r.*, nerve ring; *sh.*, sheath.

Microfilaria species (?DIROFILARIA SCAPICEPS)

Figure 1

In common with many other microfilariae from the blood of mammals, each larva is enclosed and retracted in a sheath. The larvae are from 303μ to 340μ long and 8μ in maximum width. The morphological details are as figured. The anterior extremity is bluntly rounded; the body is of more or less uniform width up to a point somewhat anterior to the first germ cell,

where it begins to taper gradually and terminates in a long slender tail with a pointed tip. The stained specimens show numerous nuclei and a number of unstained areas. A small area immediately posterior to the head end is unstained. Another unstained area, which extends across the width of the body and is located at a distance of from 66 to 70μ from the anterior extremity, is the nerve ring. At a distance of from 22 to 29μ posterior to the nerve ring is the first so-called V-shaped spot which contains an opening to the outside; this is the excretory pore (*e. p.*). Immediately behind the excretory pore is the excretory cell (*e. c.*). At the point corresponding approximately to the middle of the body is the commencement of the so-called germinal mass (*g. m.*) which occupies an area about 40μ long and is characterized by the presence of minute granules; comparatively few nuclei are present in the field occupied by the granular mass. The nucleus of the first germ cell (g^1) is located at a distance of approximately 66μ from the posterior extremity; the remaining three germ cells (g^2, g^3, g^4) are smaller than and posterior to the

TABLE 1. DIMENSIONS AND PROPORTIONS OF MICROFILARIA SP. IN THE HEART BLOOD OF LEPUS WASHINGTONII AT ARLINGTON, WASH.

	No. 1	No. 2	No. 3	No. 4	No. 5
(1) Length (without sheath)	340	315	320	303	315
(2) Maximum width	8	8	8	8	8
(3) Distance from anterior extremity to nerve ring	70	66	66	70	70
(4) Distance from nerve ring to excretory pore	29	26	24	22	25
(5) Length of tail	44	42	47	37	40
(6) Percentage of body length anterior to nerve ring	20.5	20.9	20.6	23.1	22.2
(7) Percentage of body length anterior to excretory pore	29.1	29.2	28.1	30.3	30.1
(8) Difference between (7) and (6)	8.6	8.3	7.5	7.2	7.9
(9) Percentage of body length anterior to tail	87.1	86.7	85.4	87.8	87.4

first one, and are located in a row one behind the other. The second unstained V-shaped spot contains an opening to the outside; this is the anal opening (*a*). The tail is from 37 to 44μ long and contains very few stained elements.

Table 1 shows the principal measurements, in microns, of five larvae, and certain size relationships in percentages. The specimens (two slides) are U. S. National Museum No. 30,105.

Microfilariae are known from the blood of various rodents, such as rabbits, ground squirrels, porcupines, and rats. Some of the forms which are known from these hosts are listed in a paper by Hall (1916). The occurrence of microfilariae in rabbits in North America was mentioned by Harken (1927) in a note dealing with the fluctuation in numbers of rabbits in Canada. This author states: "Specimen consisting of hind leg of rabbit was infected with *Coenurus serialis* which

is an intermediate stage of a tapeworm, the other host of which is the dog tribe. The carcass was in poor condition for critical work but some microfilaria (microscopic worms) were found in the blood and some indication of the presence of protozoa." No further details concerning the microfilariae found in rabbits are given in Harken's brief report.

A species of microfilaria from a rabbit in Algeria, probably *Lepus sefranus*, specifically distinct from the worm discussed in this paper, was described by Foley, Catanei and Vialatte (1926), and regarded by these writers as probably identical with a microfilaria described by Balfour (1911) from a rabbit, probably *Lepus hawkeri*, from the Anglo-Egyptian Soudan, and also apparently identical with the larvae of *Filaria numidica* Seurat, 1917, from the abdominal cavity of *Lepus pallidor* and *L. kabylicus* of Algeria.

Considering the medical importance of filariasis and the need for further investigations on the therapeusis and other aspects of this disease, the occurrence of microfilariae in rabbits in North America, definitely established by the data presented in this paper, opens up the possibility of transmitting filariasis to domestic rabbits experimentally. In the event that this can be accomplished, it will facilitate investigations on the treatment and on various phases of the biology of filarial infections.

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ENTOMOLOGY.—*Three new Braconidae parasitic on bark beetles.*[1]

R. A. CUSHMAN, Bureau of Entomology. (Communicated by HAROLD MORRISON.)

The three new species described below have all been reared in connection with studies of certain bark beetles, carried on by agents of the Bureau of Entomology. Of particular interest is the *Meteorus*, since most of the species of this genus are parasitic on lepidopterous larvae.

[1] Received May 19, 1931.

Meterous hypophloei, new species.

In Muesebeck's key to North American species[1] this species runs best to *fumipennis* Muesebeck. From that species it may be immediately distinguished by its stouter thorax, coarsely sculptured hind coxae, more slender subapical flagellar joints, and generally darker color, and by other details. Specimens with the wings less distinctly infumate will run to *humilis* (Cresson), differing in the longer malar space, much longer and more slender antennae, thicker head, smaller ocelli, and shorter ovipositor.

Female.—Length 3.5 mm. Head thick, not or barely twice as broad as thick medially, full behind the eyes; ocelli placed well in front of posterior tangent of eyes, very minute, the diameter of a lateral ocellus only about one-sixth the length of the ocell-ocular line; face nearly twice as broad as long, its shortest breadth subequal to the length of the eye; malar space fully as long as basal width of mandible; clypeus nearly twice as broad as long, arcuately emarginate at apex; vertex and temples polished, frons laterally punctate, face minutely rugulose opaque; antennae very nearly as long as body, slender, about 28-jointed, all flagellar joints longer than thick. Thorax hardly two and a half times as long as broad; notauli strong and meeting behind in a coarsely sculptured depression, prescutum densely punctate, lateral lobes polished; scutellum small, triangular, strongly convex, smooth and polished; propodeum irregularly reticulate rugose with more or less distinct median and basal carinae, posterior face impressed but only obsoletely outlined; thorax laterally, except small polished areas on mesopleurum, rugulose opaque; second abscissa of radius about twice as long as first; cubitus originating very close to parastigma; lower abscissa of basella about as long as nervellus; legs slender; hind coxae roughened and opaque. Abdomen about two and one-half times as long as broad; first tergite less than twice as long as broad at apex, obscurely longitudinally striate, with deep pits dorsally, the lateral edges nearly parallel; sheath a little more than half as long as abdomen, very slender, ovipositor slightly decurved.

Piceous black, with head and legs largely, pronotum and middle and extreme base of abdomen more reddish, the face and lower part of head and mandibles ferruginous; coxae sometimes nearly black; wings faintly infumate, more strongly so about junction of basal and median carinae and about base of radius, stigma blackish, pale at base, tegulae reddish.

Male.—Head even thicker than in female with temples and cheeks more strongly rounded; face distinctly broader than length of eye; abdomen about three times as long as broad; otherwise like female.

Host.—*Hypophloeus* sp.

Type-locality.—Metaline Falls, Wash.

Type.—Cat. No. 43,634, U.S.N.M.

Described from 13 females and 5 males reared April 25 to July 30, 1930, by Donald DeLeon under Hopkins U. S. No. 19758 from the larvae of the host species in western white pine trees killed by *Dendroctonus monticolae* Hopk.

[1] Proc. U. S. Nat. Mus., vol. 63, art. 2, 1923.

Coeloides dendroctoni, new species.

Female.—Length 4 mm. or less. Head nearly as broad behind eyes as at eyes, the temples strongly convex, the width from front to back about equal to that of eye; the so-called "mouth opening" much narrower than its distance from the eye and about as broad as length of malar space; malar space about half as long as eye; face minutely punctate; clypeal groove distinct medially; antennae slender, third joint of flagellum hardly concave below, very nearly as long as fourth, the latter fully twice as long as thick. Thorax weakly depressed, polished and virtually unsculptured throughout, only the metapleurum sparsely punctate; scutellar fovea minutely foveolate; stigma broad, radius slightly before middle; second cubital cell long, the second abscissa of radius much longer than first intercubitus and parallel with second abscissa of cubitus. First tergite much longer than broad, finely rugulose, the lateral furrows foveolate, the median area about three times as broad as the lateral rims; second tergite shorter than third, more or less emarginate in apical middle, more or less rugose medially and with a more or less distinct raised area in basal middle; sheath about three-fourths as long as body (relatively longer in small specimens).

Head black, orbits, cheeks, malar space, mandibles, and clypeus testaceous; labium, maxillae, palpi, and antennae black; thorax and legs black, trochanters and apices of front femur and tibia more or less reddish, postscutellum and a median streak on propodeum also more or less reddish; abdomen usually testaceous with only the first tergite black, in small specimens more or less blackish with tergites 2 and 3 pale or largely brownish black.

Male.—Essentially like female, but more frequently with abdomen largely blackish and often with apex and lateral areas of scutellum stramineous.

Type-locality.—Sula, Montana.

Type.—Cat. No. 43,635, U.S.N.M.

Hosts.—*Dendroctonus monticolae* Hopk.; *Ips oregoni* (Eich.).

Described from 32 females and 21 males reared by D. DeLeon of the Bureau of Entomology, United States Department of Agriculture, at type-locality (Hopkins U. S. Nos. 19676 [type], 19677, 19654, 19669 [allotype], 19607, 19653, 19679, 19673, 19675, 19660, 19661, 19668, 19670, 17269, 17270, 17271, 17272, 17273); Troy (Hopkins U. S. No. 19665) and Anaconda (Hopkins U. S. No. 19684), Montana; Spencer (Hopkins U. S. No. 19682), Idaho, and Metaline Falls (Hopkins U. S. No. 19801), Washington; and by J. E. Patterson, also of the Bureau of Entomology, at Crater Lake Park, Dugon (Hopkins U. S. Nos. 16266a and 16258a). The specimens under Nos. 17269 to 17273 from Sula, Montana, are labelled as having doubtfully been reared from *Ips oregoni*.

Coeloides scolyti, new species.

Very closely related to *brunneri* Viereck and perhaps only a variant of that species. Structurally the two species form an almost unbroken variation series, *scolyti* on the average having the thorax a little less depressed, the face a little broader, the head a little longer behind the eyes, the first tergite a little broader, the second a little more deeply emarginate in the middle, the ovipositor a little shorter, and the second abscissa of radius a little shorter as compared with the first intercubitus.

In color the two species are very similar, the head and abdomen being ferruginous and the thorax, legs, and antennae black or piceous. But whereas *brunneri* has the thorax and legs piceous, and the first tergite ferruginous and a diffusion of dark color about the ocellar spot especially in the male, in which sex nearly the entire vertex and frons are piceous, *scolyti* has the thorax and legs black or very nearly so, the first tergite largely blackish, and the black of the head in both sexes confined within the ocellar triangle.

Female.—Head in dorsal view nearly as long as broad, nearly as broad behind eyes as at eyes, temples very strongly convex, antero-posterior width distinctly greater than that of eye; "mouth opening" narrower than malar space, the latter half as long as eye; face minutely punctate, nearly a half broader than length of eye; clypeal groove distinct and punctiform medially; antennae slender, third joint of flagellum slightly concave ventrally and distinctly shorter than fourth, which is more than twice as long as thick. Thorax hardly depressed, polished, with only metapleurum sparsely punctate; scutellar groove minutely foveolate; stigma broad with radius far before middle; second cubital cell rather short, the second abscissa of radius at most only a little longer than first intercubitus. First tergite about a half longer than broad, its sides beyond the spiracles a little bulging, median area obscurely longitudinally striate; second tergite much shorter than third, deeply emarginate in apical middle, with a longitudinal elevation in basal middle, more or less distinctly rugulose medially, and with an oblique groove laterally terminating near the posterior margin in a distinct lunule; abdomen otherwise polished; sheath usually a little longer than body.

Head and abdomen bright ferruginous, with ocellar spot and first tergite except apex black; thorax, legs, and antennae black with legs apically and thoracic sutures more or less piceous, apex and lateral areas of scutellum sometimes pale; wings weakly infumate, venation blackish.

Male.—Essentially like female.

Host.—*Scolytus* spp.

Type-locality.—Metaline Falls, Wash.

Type.—Cat. No. 43,636, U.S.N.M.

Described from 9 females and 2 males as follows: two females including type, Hopkins U. S. No. 19899–1, from the type-locality, reared July 9, 1930, by Donald DeLeon from bark of white fir infested by *Scolytus* sp.; one female and one male, including allotype, Hopkins U. S. No. 19972, taken August 5 and 6, 1930, by D. DeLeon on *Abies grandis* infested by *Scolytus ventralis* at the type-locality; one male, Hopkins U. S. No. 19809–1, reared from *Scolytus* (?) in *Tsuga* August 16, 1930, by same collector and at same locality; three females, Hopkins U. S. No. 18146d, taken by F. P. Keen on *Abies concolor* at Pinehurst, Oregon; one female, Pyramid Ranger Station, Calif., July 22, 1915, F. B. Herbert; one female, Fallen Leaf, Calif., July 28, 1925, F. B. Herbert; and one female, Easton, Wash., Albert Koebele.

ENTOMOLOGY.—Adoretus luridus *Blanchard and its near relatives in the Philippine Islands.*[1] Edward A. Chapin, Bureau of Entomology. (Communicated by HAROLD MORRISON.)

Adoretus luridus Blanchard, a beetle of the subfamily Rutelinae of the family Scarabaeidae, was described in 1850 from a specimen or specimens taken at Manila, Luzon, P. I. The species has since been reported from various stations in the Philippines, from Malacca, and from southern Indo-China. One specimen from Singapore (C. F. Baker), which may belong to this species, is in the National collection.

A study of the specimens which have been determined in the past as this species and which are available to me shows them to fall naturally into three groups, characterized by differences in size, structure, and, to a degree, in geographical distribution. Starting with the belief that the material did actually represent a single species and intending to illustrate the variation which was thought to exist in the form of the aedeagus, the writer dissected most of the male specimens to disclose the chitinous parts of the genitalia. After learning that there were three types of aedeagus in the lot, with apparently no intergrading specimens, a study of the external anatomy was made. Differences, previously overlooked, were noted and the writer was forced to the conclusion that three closely related species were represented. The three species agree in the following points:

Upper surface sparsely and irregularly clad with pale, depressed setae. Clypeus broadly, almost semicircularly rounded with its anterior margin strongly reflexed, clypeus and frons furnished with aciculate punctures, a narrow transverse line across the vertex smooth and without punctures, occiput with coarse, transverse punctures. Eyes moderately prominent, ocular canthus narrow, reaching back about one-third diameter of eye. Pronotum transverse, about twice as wide as long, marginal bead complete on all sides. Elytron with three poorly defined costae, two of these discal, the other subhumeral, sutural bead broad. Abdominal sternites each with a transverse submarginal row of conspicuous spine-like setae, the row on the sixth sternite becoming marginal at the sides. Anterior tibiae with three teeth on outer side, middle and posterior tibiae surate, each with two oblique rows of four or five spines each. Outer claw of anterior and middle tarsi thickened and split at tip, that of posterior tarsus simple. In the descriptions that follow, the information given above is not repeated.

ADORETUS LURIDUS Blanchard.

Figures 1, 4–9

Color yellow-brown, head, pronotum (flanks excepted), and elytral suture piceous, tarsi castaneous. Clypeo-frontal suture nearly straight. Pronotum never less than twice as broad as long, sides subangulately rounded, basal

[1] Received May 19, 1931.

angles broadly rounded, anterior angles almost right, hardly produced, lateral and basal marginal beads narrow, lateral margin finely crenulate, anterior marginal bead broad and flat. Punctures coarse and sparse, evenly distributed or nearly so. Scutellum with a few coarse punctures. Elytron with intercostal spaces densely set with coarse punctures, the punctures between the discal costae roughly arranged in four rows. Apical sutural angle well-defined but blunt. Pygidium finely but roughly sculptured at sides, nearly smooth at middle, pubescence longer and more conspicuous at middle, lower margin sinuate, apex subtruncate and slightly reflexed. Upper tooth of anterior tibia well-developed.

Length 9–10.5 mm.

Apparently a common species at Manila, whence it was originally described. Its distribution is to the south and along the south shore of Laguna de Bay. Specimens before me are from: Manila Prov., Manila; Cavite Prov., Bacoor; Laguna Prov., Los Baños and Mt. Makiling. While there is some variation in the intensity of the coloration (occasionally a specimen with an almost entirely pale pronotum occurs), none of the specimens fails to show the dark sutural stripe.

ADORETUS PHILIPPINICUS Pic.

Figures 2, 10–21

Similar in general appearance to *A. luridus* Blanchard but smaller, with the antennal club (male) proportionately much longer. Color yellow-brown, head, pronotum (except for small spot on flanks), and tarsi piceous, elytra often entirely dark but always with a dark suture. Head flat, clypeo-frontal suture feebly angulate at middle. Pronotum never quite twice as broad as long, sides rounded, lateral margins distinctly crenulate, marginal bead complete, anterior angles almost right, somewhat blunted at apices, basal angles effaced. Disc with a very few large punctures, flanks more densely punctured. Scutellum rough, without definite punctures. Apical sutural angle of elytron very broadly rounded. Pygidium covered with very fine scratches and with some very fine punctures, from each of which there arises a yellowish hair. Anterior tibia with upper tooth very weakly developed.

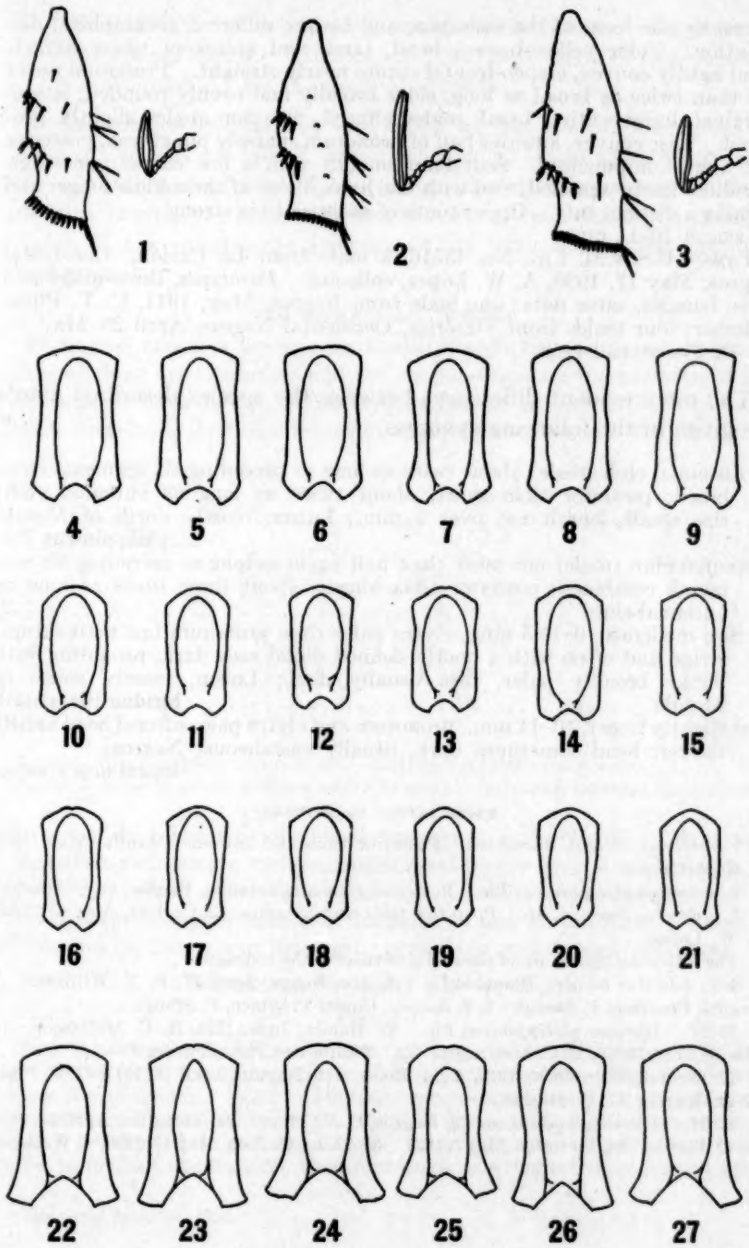
Length 7.5–9 mm.

A. philippinicus Pic. was described in Le Naturaliste, Ser. 2, Vol. 19, p. 131, 1905. The species is more northern in its distribution than *A. luridus* Blanchard, specimens having been identified from Benguet and Union provinces, as well as from Manila. The figure of the aedeagus given by Ohaus (Deutsche ent. Zeitsch., 1914, p. 472, fig. 1) as of *A. luridus* Blanchard appears to be of this species. The National collection contains specimens from: Benguet Prov., Baguio; Union Prov., Bayana; Manila Prov., N. W. shore of Laguna de Bay, and Manila. Also four specimens from the Baker collection labelled "Philippines-Schadenberg."

Adoretus lopezi, new species.

Figs. 3, 22–27

Larger and paler than either of the preceding species, distinguished by the uniformly pale pronotum, the virtual absence of the sutural stripe on the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elytra, by the form of the aedeagus, and by the different geographical distribution. Color yellow-brown, head, tarsi, and apices of tibiae darker. Head lightly convex, clypeo-frontal suture nearly straight. Pronotum never less than twice as broad as long, sides broadly and evenly rounded, lateral margins almost entire, basal angles effaced, anterior angles slightly produced. Disc convex, anterior half of pronotum sparsely punctured, posterior half almost impunctate. Scutellum smooth with a few coarse punctures. Pygidium finely wrinkled, clad with fine hairs, those at the middle longer and forming a distinct tuft. Upper tooth of anterior tibia strong.

Length 10–11 mm.

Type.—U.S.N.M. Cat. No. 43516, a male from La Carlota, Occidental Negros, May 17, 1930, A. W. Lopez, collector. *Paratypes*, three males and three females, same data; one male from Negros, May, 1911, C. V. Piper, collector; four males from Victorias, Occidental Negros, April 25–May 15, W. D. Pierce, collector.

The more evident differences between the species described above are given in the following synopsis.

1. Antennal club (male) about twice as long as preceding six segments combined; posterior tibia short, about twice as long as antennal club; size small, length not over 9 mm.; Luzon, mostly north of Manila **philippinicus** Pic.

Antennal club (male) not more than half again as long as preceding six segments combined; posterior tibia longer, about three times as long as antennal club.....2.

2. Size moderate, 9–10.5 mm., elytra paler than pronotum but with sutural stripe and often with a poorly defined discal area dark, pronotum with flanks broadly paler, disc usually dark; Luzon, mostly south of Manila.....**luridus** Blanchard.

Size slightly larger, 10–11 mm., pronotum and elytra pale, sutural bead hardly darker, head sometimes dark, usually castaneous; Negros **lopezi** new species.

EXPLANATION OF FIGURES

1. *Adoretus luridus* Blanchard. Posterior tibia and antenna, Manila, May, 1925, R. C. McGregor.

2. *Adoretus philippinicus* Pic. Posterior tibia and antenna, Baguio, G. G. Haslam.

3. *Adoretus lopezi* n. sp. Posterior tibia and antenna, La Carlota, May 17, 1930, A. W. Lopez.

The following figures are of the distal portion of the aedeagus:

4–9. *Adoretus luridus* Blanchard. 4–6, Los Baños, April 17, F. X. Williams. 7, Laguna Province, P. Stangl. 8, 9, Bacoor, Cavite Province, P. Stangl.

10–21. *Adoretus philippinicus* Pic. 10, Manila, June, 1924, R. C. McGregor. 11, Manila, May, 1925, R. C. McGregor. 12, "Philippines, Schadenberg."

13–15, Manila Province, 1913, A. M. Reese. 16, Baguio, April 10, 1911, C. V. Piper. 17–21, Baguio, G. G. Haslam.

22–27. *Adoretus lopezi* n. sp. 22, Negros, C. V. Piper. 23, Victorias, April 21, 1928, W. D. Pierce. 24, Victorias, May 7, 1929. 25–27, La Carlota, May 17, 1930, A. W. Lopez.

ENTOMOLOGY.—*New species of melolonthine Scarabaeidae from the Philippine Islands.*[1] EDWARD A. CHAPIN, Bureau of Entomology. (Communicated by HAROLD MORRISON.)

Of the species described in this paper, all but one originated on the island of Negros, an island whose scarabaeid fauna appears to have been somewhat neglected in the past. The remaining species, from southern Luzon, has been included because of its evident relationship to one of the others and because of its very interesting pronotal development.

STEPHANOPHOLIS Brenske.

This genus contains five species in addition to the one described below. Three of these are Ceylonese and are characterized by the presence of but five costae on each elytron. The type locality of the genotype, *S. melolonthoides* Brenske, is doubtful; however, the species agrees with the Philippine

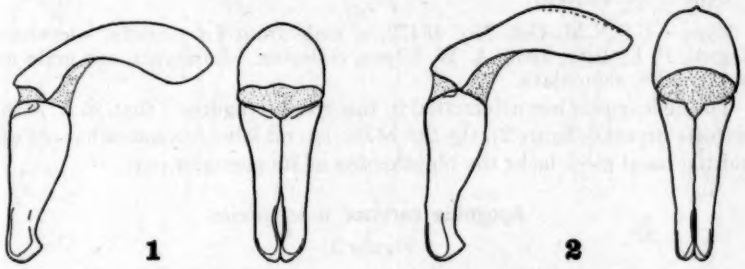

Figure 1. *Stephanopholis lopezi* n. sp. Aedeagus, side and front views.
Figure 2. *Stephanopholis philippinensis* Brenske. Aedeagus, side and front views.

members of the genus in having fourteen costae on each elytron. This species is described as having a median longitudinal furrow on the ventral face of the abdomen which is completely scaled. *S. philippinensis* Brenske and *S. lopezi* new species agree in having the scales of the ventral furrow, which is not continuous throughout its length, grouped in well-defined oval spots.

Stephanopholis lopezi new species.

Figure 1

Near *S. philippinensis* Brenske, but distinguished from that species by the more robust form, the more uniform elytral costae, and the differences in the aedeagus of the male. Head and clypeus coarsely, shallowly, and not densely punctured, each puncture bearing a single elongate scale. Pronotum one and one-half times as wide as long, laterally angulate, sides parallel from basal angles to median angulations, thence strongly convergent to anterior angles

[1] Received May 19, 1931.

where width is slightly less than median length, lateral margins narrowly reflexed. Surface, on either side of the moderately broad and flat, smooth median ridge, rather less densely punctured than head, each puncture bearing a broadly oval scale. Elytra each with fourteen broad and nearly uniform costae, the intervening sulci densely set with small oval scales. Costae 1, 4, 7, 10, 13, and 14 reaching and joining the basal margin; 5 and 6, also 11 and 12, anastomosing both anteriorly and posteriorly; 4 and 7, also 3 and 8, forming complete loops posteriorly; 8 and 9 anastomosing posteriorly. Pygidium evenly scaled, sides nearly straight and strongly convergent, apex narrowly truncate. Underparts densely clad with small scales, sternites 2, 3, and 4 polished medianly and each with an oval spot of scales on the median line. Legs slender, anterior tibia bidentate, claw with a small sharp tooth just in front of the slight basal swelling of lobe.

Male.—Clypeus more than twice as broad as long (by measurement), strongly reflexed, broadly and shallowly emarginate anteriorly, anterior angles rounded. Antennal club longer than stem.

Female.—Clypeus trapezoidal, more than three times as broad as long, anterior margin more strongly reflexed at middle where it is slightly notched, anterior angles obtuse. Antennal club shorter than stem.

Length 21–26 mm.

Type.—U.S.N.M. Cat. No. 43472, a male from La Carlota, Occidental Negros, P. I., June, 1930, A. W. Lopez, collector. *Paratypes*, one male and two females, same data.

The aedeagus is less attenuated in this species (figure 1) than in *S. philippinensis* Brenske (figure 2), the tips of the lateral lobes are somewhat oblique, and the basal piece lacks the blunt carina as its posterior part.

Apogonia carlotae new species.

Figure 3.

Near *A. adoretoides* Ritsema but larger and with distinctive differences in the aedeagus. Uniform deep piceous brown, evenly clad with short, depressed, ashy hairs. Clypeus evenly curved, anterior margin strongly reflexed, punctures coarse and closely set. Clypeo-frontal suture not sharply impressed. Frons slightly elevated, evenly convex, asperately punctured, the punctures smaller but about as numerous as those on clypeus. Pronotum twice as broad as long (by measurement), anterior margin not beaded, lateral and basal margins with fine bead, punctures moderately fine, notably more densely set laterally than on disc. Scutellum six-tenths as long as wide, uniformly and densely set with punctures similar in size to those on pronotum. Elytron evenly, densely and moderately finely punctured, toward apex the punctures becoming finer and even more closely set. Underparts densely and finely punctured. Anterior tibia bidentate toward apex and with a rudimentary tooth near base. Claw cleft to about middle of length, the inner ramus broader than outer.

Length 10–11 mm. (type 10.7 mm.).

Type.—U.S.N.M. Cat. No. 43473, a male from La Carlota, Occidental Negros, May 17, 1930, A. W. Lopez, collector. *Paratypes*, four males and two females, same data.

Compared with *A. adoretoides* Ritsema, the new species is larger. The longest of our twenty-three specimens of *A. adoretoides* Ritsema (from various localities on Luzon) measures 9.5 mm., the shortest 8.5 mm. In *carlotae* the tarsi, especially the posterior pair, and the posterior tibial spurs are broader than in *adoretoides*. The differences in the aedeagi of the two species are indicated in the drawings (figures 3 and 4). In both species the flagellum at the tip of the narrower of the lateral lobes is loosely attached and has freedom of motion in any direction.

Holotrichia sexspecula new species.

Near *H. mindanaona* Brenske but with the integuments generally pruinose and with a quite different development of the pronotum and elytra. Dark castaneous above, abdomen somewhat paler. Head shining, coarsely and densely punctured, clypeus feebly bilobed with anterior margin reflexed, frons with a median shallow depression flanked either side by a low tubercle.

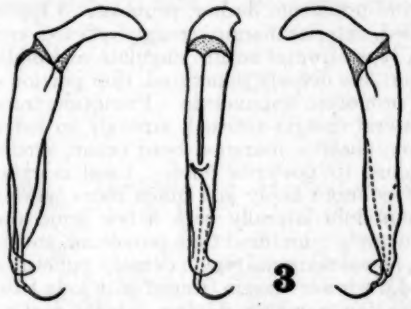

Figure 3. *Apogonia carlotae* n. sp. Aedeagus; right, front, and left views.
Figure 4. *Apogonia adoretoides* Rits. Aedeagus, right and left views.

Pronotum broader than long (length—width ratio = 46:76), sides angulately rounded at middle, anterior and posterior margins fine but complete, lateral marginal carina fine at posterior angle and continued so to the apex of the median angulation where it ceases. At the anterior angle the carina is modified into a broad, rounded explanate flap. Between the flap and the angulation, the normal course of the carina is traced by a series of punctures. Surface rather finely but not densely punctured, with an even pruinosity except for four spots: two semicircular spots on anterior margin, one either side of the middle, and one large rounded spot on anterior half of each lateral angular protuberance. Scutellum with a few scattered punctures. Elytra with suture tumid, densely punctured in the vicinity of the scutellum, more sparsely punctured elsewhere, pruinose except for a large lateral area commencing at humeral callus and reaching half way to apex. Close to the suture near apical fourth there is a roughened spot of small size from which grow two tufts of ferruginous hairs. Pygidium roughly triangular, apex rounded and very densely punctured, with a few hairs along its margin. Metasternum shaggy with whitish hairs, abdominal sternites with a few very short hairs, second

visible sternite with a dense patch of hair laterally. Anterior tibia tridentate, posterior tibial spurs acute-spatulate, first segment of posterior tarsus shorter than second, claw strongly hooked, furnished with a small, acute, subbasal tooth.

Length (from apex of clypeus to apex of elytral suture) 19 mm.

Type.—U.S.N.M. Cat. No. 43474, a female from Cuernos Mountain, Oriental Negros, C. F. Baker, collector.

Owing to the unnatural distortion of the abdomen due to shrinkage, the over-all measurement is not given. The fascicles of hair on the elytra appear most unusual.

Holotrichia negrosiana new species.

Figure 5.

In size, comparable to *H. philippinica* Brenske but differs from this species by the presence of a well-marked pruinosity in the male and by the long first posterior tarsal segment.

Male.—Color castaneous, head and pronotum darker, pruinose. Clypeus angulately emarginate, almost bilobed, anterior margin strongly reflexed, very coarsely and closely punctured. Clypeo-frontal suture angulate at middle, finely impressed. Frons coarsely but less densely punctured, that portion of vertex usually carried beneath the pronotum impunctate. Pronotum transverse, sides angulate at middle, lateral margin reflexed, strongly so before and feebly so behind the angulation, anterior marginal bead entire, moderately broad and finely crenulate along its posterior border, basal marginal bead incomplete across disc. Surface more finely and much more sparsely punctured than that of head. Scutellum laterally with a few punctures. Elytron finely and somewhat more densely punctured than pronotum, sutural margin feebly but broadly elevated, apical marginal region densely punctured. Pygidium rather sparsely punctured, its lower margin fringed with long hairs. Underparts sparsely punctured, median portions shining, lateral portions dull, legs shining, anterior tibia tridentate, first posterior tarsal segment as long as second, claw with a small, sharp, submedian tooth.

Female.—Similar to male except that the elytra are more coarsely punctured and, when clean, strongly shining.

Length 12.5–14.5 mm. (type 14 mm.).

Type.—U.S.N.M. Cat. No. 43475, a male from La Carlota, Occidental Negros, May 17, 1930, A. W. Lopez, collector. *Paratypes*, 22 males and 28 females (pinned) and numerous males and females in alcohol, same data.

The pinned material was passed through strong alcohol and xylol before pinning in order to extract the contained fat; in such specimens the more shining integuments of the females are readily observed. The aedeagus is figured (figure 5).

Holotrichia stylifer new species.

Figure 6

Size and form of *H. mindanaona* Brenske. Shining, color pale brown with head, pronotum, and legs dark. Clypeus feebly, angulately emarginate at middle, anterior margin not strongly reflexed, punctures moderate in size and

rather sparsely placed, clypeo-frontal suture sinuate, front more sparsely punctured than clypeus. There is a faint median depression on the frons. Pronotum transverse, widest across middle, sides obtusely angulate but not strongly produced, marginal bead fine and complete laterally and basally, anterior marginal bead broader and flat, its margins entire, surface more sparsely but equally coarsely punctured with head, anterior angles rounded and very slightly produced, lateral margin just behind the anterior angles slightly reflexed, basal angles rounded. Scutellum sparsely punctured. Elytron with punctures of equal size and density to those of pronotum, sutural margin faintly and broadly elevated, without other costae. Pygidium sparsely punctured, its lower margin fringed with long hairs. Underparts feebly punctured, shining but with latero-ventral opaque spots on 3rd and 4th sternites. Anterior tibia tridentate, first posterior tarsal segment equal in length to second, claw with a minute, sharp, recurved denticle on the basal lobe. Aedeagus shown in figure 6.

Length 16.5–19 mm. (type 18 mm.).

Type.—U.S.N.M. Cat. No. 43476, a male from La Carlota, Occidental Negros, May 17, 1930, A. W. Lopez, collector. *Paratypes*, two males and

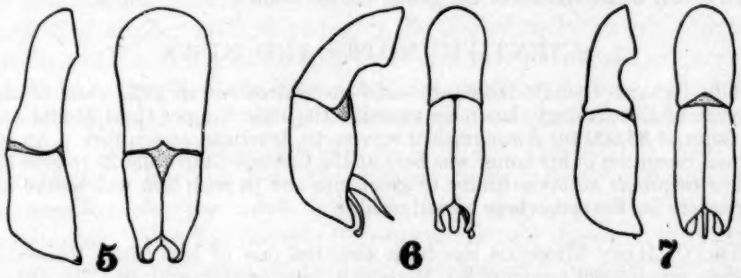

Figure 5. *Holotrichia negrosiana* n. sp. Aedeagus, side and front views.
Figure 6. *Holotrichia stylifer* n. sp. Aedeagus, side and front views.
Figure 7. *Holotrichia sorsogona* n. sp. Aedeagus, side and front views.

one female, same data as type; one male from Saravia, Occidental Negros, May 12, 1929, W. D. Pierce, collector; three males and one female from Victorias, Occidental Negros, Oct. 4 and 7, 1927, Nov. 28, 1928, and Oct. 16, 1929, W. D. Pierce, collector; two males and one female, Cuernos Mountain, Oriental Negros, C. F. Baker, collector.

Holotrichia sorsogona new species.

Figure 7.

Near to *H. stylifer* new species; shining, color light castaneous, head and pronotum slightly darker. Clypeus with a shallow, angulate emargination, anterior margin reflexed, surface rather coarsely and quite densely punctured, clypeo-frontal suture sinuate, frons as coarsely but less densely punctured than clypeus, with a broad, shallow, but very evident depression, vertex strongly punctured. Pronotum transverse, widest across apices of lateral angulations, lateral margins, commencing at the rounded and hardly produced anterior angle, running straight back for one-fourth length of pronotum,

there turning sharply outward to form an angle of about 140°, then turning inward to the obtuse basal angle, forming a lateral angle of about 90°, which is itself broadly rounded. Marginal bead fine and entire, the anterior lateral margins slightly flattened and produced. Surface more finely and sparsely punctured than head. Scutellum evenly and densely punctured. Elytron more finely and densely punctured, with three faintly indicated costae in addition to the slightly raised sutural margin. Pygidium coarsely, deeply, but not densely punctured. Underparts finely and sparsely punctured, metasternum clad with long hairs, anterior tibia tridentate, first posterior tarsal segment shorter than second, claw with minute denticle on basal lobe. Aedeagus figured (figure 7).

Type.—U.S.N.M. Cat. No. 43477, a male from Sorsogon, Southern Luzon, C. F. Baker, collector.

In the structure of the male genitalia and in the tarsal claws this species is closely related to the preceding. There appears to be no supplementary style attached to the wall of the internal sac as in that species, however. The development of the sides of the pronotum is much more exaggerated here than in any other species of the genus known to me.

SCIENTIFIC NOTES AND NEWS

DR. LELAND OSSIAN HOWARD, until his retirement in 1927 chief of the Bureau of Entomology, has been awarded the 1931 Capper Gold Medal and the sum of $5,000 for distinguished service to American agriculture. An informal reception in his honor was held at the Cosmos Club June 29 to give his fellow members an opportunity to greet him and to wish him well before his departure for France, where he will reside.

DR. C. HART MERRIAM has been awarded one of the three Roosevelt medals given each year by the Roosevelt Memorial Association for distinguished service. The award was given to Dr. Merriam for distinguished service in the advancement of the study of natural history. He founded, in 1885, the division of ornithology and mammalogy in the Federal Department of Agriculture, which later became the Bureau of Biological Survey, and, as its chief for 25 years, introduced methods of research and study which constitute the basic structure of the present American school of mammalogy.

DR. ALEXANDER WETMORE has been elected an honorary member of the Hungarian Ornithological Society, and has also been awarded the Otto Herman silver medal by that society.

NATHAN W. BASS has been reinstated in the Geological Survey and assigned to the geologic branch.

E. T. WHERRY, Associate Professor of Botany, University of Pennsylvania, is collecting and studying the Polemoniaceae or Phlox family in the Northwestern States.

On July 1, the division of agricultural engineering of the Bureau of Public Roads became an independent bureau of the Department of Agriculture, with the name, Bureau of Agricultural Engineering. S. H. MCCRORY, head of the former division, has been appointed chief of the new bureau.